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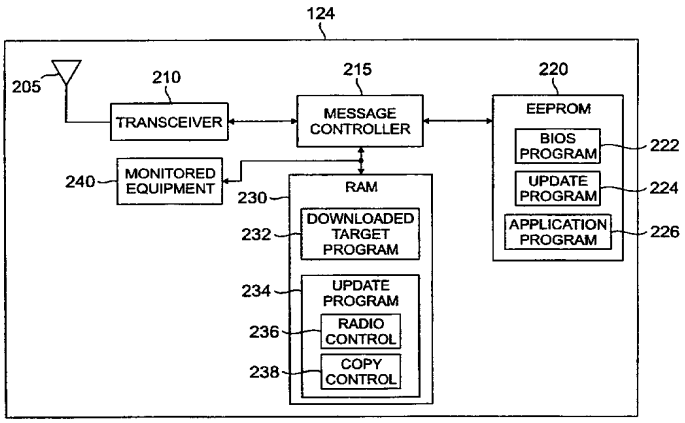
(54) Title: SYSTEM AND METHOD FOR OVER-THE-AIR REPROGRAMMING OF AN ADVANCED WIRELESS MESSAGING DEVICE



(57) Abstract: There is disclosed, for use in a wireless messaging device, an update controller for performing an over-the-air (OTA) update of a first program stored in an erasable read-only memory (ROM) (220) in the wireless messaging device. The update controller comprises: 1) a transceiver (210) for transmitting and receiving wireless messages to and from a base station in a wireless network, and 2) a message controller (215) coupled to the transceiver for detecting an OTA update message transmitted by the base station. In response to detection of the OTA update message, the message controller (215) transfers an update control program (224) stored in the erasable ROM (220) to a random access memory (RAM) coupled to the message controller (215) and executes the update control program from the RAM (230). Under control of the update control program (224) in RAM (230), the message controller (215) receives a replacement program over the air and overwrites at least a portion of the first program stored in the erasable ROM (220).

WO 01/17214 A1

SYSTEM AND METHOD FOR OVER-THE-AIR REPROGRAMMING OF AN ADVANCED WIRELESS MESSAGING DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

The present invention is related to those disclosed in the following United States Patent Applications:

1. Serial No. 09/002,191, filed December 31, 1997, entitled "ANTENNA SYSTEM FOR NARROWBAND COMMUNICATIONS SYSTEMS AND METHOD OF OPERATION";

2. Serial No. 09/001,717, filed December 31, 1997, entitled "CONTROLLER FOR USE WITH COMMUNICATIONS SYSTEMS FOR CONVERTING A VOICE MESSAGE TO A TEXT MESSAGE";

3. Serial No. 09/001,759, filed December 31, 1997, entitled "SYSTEM FOR SCHEDULING REVERSE-CHANNEL MESSAGES IN NARROWBAND COMMUNICATIONS SYSTEMS AND METHODS OF OPERATION";

4. Serial No. 09/138,438, filed August 21, 1998, entitled "SYSTEM AND METHOD FOR MODELING SIMULCAST DELAY SPREAD AND OPTIMIZING LAUNCH DELAYS";

5. Provisional Serial No. 60/098,873, filed September 1, 1998, entitled "NARROWBAND TELEMETRY SYSTEM AND METHODS OF OPERATION";

6. Serial No. [Attorney Docket No. PAGE01-00149], filed concurrently herewith, entitled "SYSTEM AND METHOD FOR CONTROLLING AN END-USER APPLICATION AMONG A PLURALITY OF COMMUNICATION UNITS IN A WIRELESS MESSAGING NETWORK";

7. Serial No. [Attorney Docket No. PAGE01-00163], filed concurrently herewith, entitled "SYSTEM AND METHOD FOR CONTROLLING TRANSMITTER POWER OF A NARROWBAND ADVANCED MESSAGING SYSTEM"; and

8. Serial No. [Attorney Docket No. PAGE01-00164], filed concurrently herewith, entitled "SYSTEM AND METHOD

FOR TRANSMITTING SUBSCRIBER DATA IN A NARROWBAND ADVANCED MESSAGING SYSTEM USING UNSCHEDULED MESSAGE TIME SLOTS."

The above applications are commonly assigned to the assignee of the present invention. The disclosures of these related patent applications are hereby incorporated by reference for all purposes as if fully set forth herein.

TECHNICAL FIELD OF THE INVENTION

The present invention is directed, in general, to wireless communication systems and methods of operating the same and, in particular, to systems and methods for reprogramming wireless messaging devices over the air.

BACKGROUND OF THE INVENTION

The demand for better and cheaper wireless communication services and equipment continues to grow at a rapid pace. Much of this growth is spurred by the Federal Communication Commission's ("FCC") approval of certain frequency bands for the next generation of Personal Communication Service ("PCS") devices that provide advanced voice and/or data messaging services, as well as voice telephone services. A relatively small portion of the available frequency bands was set aside for narrowband PCS ("NPCS") to encourage efficient use of the available spectrum. There are a number of well-known wireless communication techniques that attempt to maximize the efficiency with which the available spectrum is used. These methods include frequency division multiple access ("FDMA"), time division multiple access ("TDMA"), code division multiple access ("CDMA"), and the like. The term "multiple access" means that multiple subscribers (or users) are able to communicate simultaneously with each of these systems.

In general, the infrastructure of a messaging system is somewhat different than cellular telephone systems. For instance, in a NPCS messaging system, all of the base station transmitters throughout a wide coverage area are synchronized and simultaneously broadcast (i.e., simulcast) a message in a forward-channel to a subscriber's wireless communication unit (e.g., portable message pagers, fixed messaging or telemetry devices, etc.). This simulcast increases the likelihood that the transmitted message will reach the device even through obstacles, such as buildings, trees, overpasses, and the like. Likewise, the subscriber communication units are capable transmitting messages in a

reverse-channel to numerous receivers associated with the base stations. However, the messaging system does not assign the subscriber to a particular cell and does not transmit to the subscriber only in one cell, as in the case of a cellular telephone system.

Telemetry systems, broadly stated, are communication systems that transmit "status" information from a remote process, function, or device (collectively, "telemetry application") to a central control facility. Telemetry systems may be used in lieu of maintenance workers to remotely monitor a given telemetry application, such as a utility meter, security system, vehicle locator, environmental monitor, vending machine, medical equipment, oil drilling equipment, and the like.

It is highly desirable to be able to update the programs in a subscriber communication unit by means of an over-the-air ("OTA") update procedure. This allows software errors to be fixed after the subscriber communication unit is distributed to end users and also allows the capabilities of the installed software to be upgraded or even completely changed. It also allows a "blank" subscriber communication unit to be distributed to an end user with only a basic operating system for controlling the radio functions of the subscriber communication unit installed in the unit, and no end-user application installed. Thereafter, the end user may install customized applications in the subscriber communication unit via an OTA update. For example, a vending machine company may purchase generic subscriber communication units and install them in vending machines. Vending machine control software may then be installed in each generic subscriber communication unit by means of an

OTA update routine. Subsequently, software corrections and upgrades may be installed by means of an OTA routine.

Unfortunately, the amount of read only memory (ROM) in a subscriber communication unit is very limited, particularly in small wireless messaging devices such as pagers. An erasable ROM is used to store the BIOS program and the end-user application for which the subscriber communication unit is used. The smallness of the erasable ROM (also known as a "flash ROM") may make it impossible to download a new application and/or BIOS program "over the air" because the BIOS program and the existing application program(s) consume too much space in the ROM.

Therefore, there exists a need in the art for systems and methods for performing over-the-air updates of wireless messaging devices. In particular, there exists a need for systems and method for performing over-the-air updates of wireless messaging devices in which the amount of erasable ROM available is severely limited.

SUMMARY OF THE INVENTION

To address the above-discussed deficiencies of the prior art, it is a primary object of the present invention to provide, for use in a wireless messaging device, an update controller for performing an over-the-air (OTA) update of a first program stored in an erasable read-only memory (ROM) in the wireless messaging device. In an advantageous embodiment of present invention, the update controller comprises: 1) a transceiver capable of receiving wireless messages from a base station in a forward channel and transmitting wireless messages to the base station in a reverse channel; and 2) a message controller coupled to the transceiver capable of detecting an OTA update message transmitted by the base station, wherein the message controller, in response to detection of the OTA update message, transfers an update control program stored in the erasable ROM to a random access memory (RAM) coupled to the message controller and executes the update control program from the RAM.

In one embodiment of the present invention, the message controller, under control of the update control program, receives from the transceiver a second program suitable for replacing the first program and stores at least a portion of the second program in the RAM.

In another embodiment of the present invention, the message controller, under control of the update control program, transfers at least a portion of the second program from the RAM to the erasable ROM.

In still another embodiment of the present invention, the message controller, in transferring the at least a portion of the second program to the erasable ROM, overwrites at least a portion of the first program.

In still another embodiment of the present invention, the update controller transmits an update request message to the base station, wherein transmission of the update request message causes the OTA update message to be transmitted to the update controller by the base station.

In a further embodiment of the present invention, the update controller periodically transmits the update request message according to a time period modifiable by a user of the wireless messaging device.

In a still further embodiment of the present invention, the update controller transmits the update request message in response to a triggering event.

In a yet further embodiment of the present invention, the triggering event is at least one of: 1) a manual input received from a user of the wireless messaging device; 2) an input received from monitored equipment coupled to the wireless messaging device; and 3) an error occurring during execution of the first program.

The foregoing has outlined rather broadly the features and technical advantages of the present invention so that those skilled in the art may better understand the detailed description of the invention that follows. Additional features and advantages of the invention will be described hereinafter that form the subject of the claims of the invention. Those skilled in the art should appreciate that they may readily use the conception and the specific embodiment disclosed as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. Those skilled in the art should also realize that such equivalent constructions do not depart from the spirit and scope of the invention in its broadest form.

Before undertaking the DETAILED DESCRIPTION, it may be advantageous to set forth definitions of certain words and phrases used throughout this patent document: the terms "include" and "comprise," as well as derivatives thereof, mean inclusion without limitation; the term "or," is inclusive, meaning and/or; the phrases "associated with" and "associated therewith," as well as derivatives thereof, may mean to include, be included within, interconnect with, contain, be contained within, connect to or with, couple to or with, be communicable with, cooperate with, interleave, juxtapose, be proximate to, be bound to or with, have, have a property of, or the like; and the term "controller" means any device, system or part thereof that controls at least one operation, such a device may be implemented in hardware, firmware or software, or some combination of at least two of the same. It should be noted that the functionality associated with any particular controller may be centralized or distributed, whether locally or remotely. Definitions for certain words and phrases are provided throughout this patent document, those of ordinary skill in the art should understand that in many, if not most instances, such definitions apply to prior, as well as future uses of such defined words and phrases.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, wherein like numbers designate like objects, and in which:

FIGURE 1 illustrates a representative portion of an exemplary messaging network in accordance with one embodiment of the present invention;

FIGURE 2 illustrates an exemplary one of the subscriber communication units for use in the network in FIGURE 1 in accordance with one embodiment of the present invention;

FIGURE 3 illustrates in greater detail a portion of the control facility in FIGURE 1 in accordance with one embodiment of the present invention; and

FIGURE 4 is a flow diagram illustrating an over-the-air software update procedure in accordance with one embodiment of the present invention.

DESCRIPTION OF THE INVENTION

FIGURES 1 through 4, discussed below, and the various embodiments used to describe the principles of the present invention in this patent document are by way of illustration only and should not be construed in any way to limit the scope of the invention. Those skilled in the art will understand that the principles of the present invention may be implemented in any suitably arranged wireless messaging network.

Turning initially to FIGURE 1, there is illustrated a representative portion of a conventional messaging network (generally designated "100" and referred to below as "network 100"). Network 100 provides two-way data messages to subscribers (or users) of network 100. Network 100 is represented by three exemplary fixed land sites, called base stations, which communicate with a plurality of subscriber communication units 121-128 (e.g., message pagers, telemetry devices, PCS devices, personal data assistants, or other processing systems that include wireless communication capability, etc.) within network 100.

Base stations 111, 112 and 113, each labeled "BS" in FIGURE 1, have coverage areas 101, 102, and 103, respectively, that are determined by the power of the transmitters in base stations 111, 112, and 113. For the purposes of illustration and discussion, coverage areas 101, 102, and 103 are shown as circles. In real world environments, however, each of coverage areas 101, 102, and 103 may differ significantly from an idealized circular form.

For purposes of illustration, a plurality of subscriber communication units, each labeled "P" in

FIGURE 1, are shown scattered throughout messaging network 100. Subscriber communication units 121 and 122 are located within coverage area 101 and may engage in two-way messaging with base station 111. Subscriber communication units 123 and 124 are located in coverage area 102 and may engage in two-way messaging with base station 112. Subscriber communication units 126, 127 and 128 are located in coverage area 103 and may engage in two-way messaging with base station 113. Subscriber communication unit 125 is located in coverage areas 102 and 103 and may engage in two-way messaging with base stations 112 and 113.

In a NPCS environment, base stations 111, 112, and 113 transmit signals in a forward-channel, such as from 939-940 MHZ, for example. Base stations 111, 112, and 113 receive signals in a reverse-channel at, for example, 901-902 MHZ. Each base station is effectively a transceiver that contains a transmitter and a receiver for carrying out two-way communications. Each subscriber communication unit receives forward-channel messages directed to it at a selected frequency within the forward-channel. Each communication also transmits reverse-channel messages at a selected frequency within the reverse-channel.

Messaging network 100 may be, for example, a two-way wireless messaging system compatible with the MOTOROLA® ReFLEX™ transport protocol. The ReFLEX™ protocol may be used to send a message to a subscriber communication unit. The subscriber communication unit may then transmit in the reverse-channel an automatic acknowledgment message that does not require subscriber action. Alternatively, the ReFLEX™ protocol may be used in an enhanced messaging mode to send a more complex message to the subscriber communication unit. The subscriber communication unit may

then transmit in the reverse-channel an automatic acknowledgment message that does not require subscriber action. Some time later, the subscriber may transmit a "canned" message stored in the subscriber communication unit, such as "Will Call You Later", or a unique message composed by the subscriber using a keypad on the subscriber communication unit.

Base station 111 transmits messages to subscriber communication units in coverage area 101. Base station 112 transmits messages to subscriber communication units in coverage area 102. Base station 113 transmits messages to subscriber communication units in coverage area 103. Base stations 111, 112, and 113 may be associated with one another and to a control facility 10 by a wired backbone, such as a proprietary fiber-optic network. In alternate embodiments, base stations 111, 112, and 113 may be associated with one another and to control facility 10 by a satellite communications link, such as through a very small aperture terminal ("VSAT").

It should be noted that while the illustrated embodiment discloses centralized control facility 10 for controlling communication among the exemplary subscriber communication units, in alternate advantageous embodiments communications control may be distributed. It should also be noted that messages may be received into control facility 10 from a variety of sources. Some messages may be received from a public telephone system in the form of simple call-back numbers entered by a caller on a DTMF keypad. Other messages may be received by control facility 10 from an Internet connection. Additionally, and most importantly in the context of the present invention, messages may be received from subscriber communication

units, such as telemetry devices dispersed over a wide area.

Turning to FIGURE 2, there is illustrated a block diagram of an exemplary one of subscriber communication units 121-128 for use in network 100. Exemplary subscriber communication unit (SCU) 124 may comprise a two-way paging device used by a subscriber or may be a part of a telemetry device that is used to transmit to network 100 measured data, status messages, alarm messages, and the like from a monitored piece of equipment in which SCU 124 is incorporated. The monitored piece of equipment may comprise a vending machine, medical equipment, a home alarm system, remote oil field equipment, remote power generation equipment, and the like.

Exemplary SCU 124 comprises antenna 205, transceiver 210, message controller 215, an electronically erasable programmable read only memory (EEPROM) 220 (referred to hereafter as "flash ROM 220"), and random access memory (RAM) 230. Optionally, in a telemetry application of the present invention, SCU 124 may also comprise monitored equipment 240 that generates telemetry data that is transmitted to control facility 10 and then relayed on to a final destination.

Antenna 205 transmits and receives RF signals between base station 112 and SCU 124, including standard NPCS communication messages and messages associated with the OTA reprogramming capability of the present invention. Transceiver 210 down-converts the received RF signals into binary messages for transfer to message controller 215 and up-converts to RF signals the binary messages received from message controller 215.

Message controller 215 comprises standard means for interfacing with transceiver 210, flash ROM 220, RAM 230,

and monitored equipment 240. Message controller 215 executes BIOS program 222 and application program 226 stored in flash ROM 220 and controls the operation of SCU 124 under the direction of these programs. Message controller 215 responds to stored OTA reprogramming messages and data to accomplish partial or complete replacement of the programs in flash ROM 220.

Under normal operating conditions, message controller 215 coordinates communications between SCU 124, any directly interfacing devices, and network 100. Periodically, message controller 215 may detect the initiation of an OTA reprogramming event. Once message controller 215 determines that an OTA reprogramming event has been initiated, message controller 215 copies update program 224 from flash ROM 220 to update program 234 space in RAM 230. At that time, message controller 215 begins to execute the update program from update program 234. When message controller 215 determines that OTA reprogramming is completed, it returns to the normal operating mode under the direction of BIOS program 222 and/or application program 226 in flash ROM 220.

Under normal operations, BIOS program 222 controls the basic operations of SCU 124, including the operation of transceiver 210. Application program 226 comprises the basic end-user application performed by subscriber communication unit 124. For example, application program 226 is a telemetry program if SCU 124 is used in a telemetry application. Alternatively, application program 226 may be a text messaging program if SCU 124 is, for example, a two-way paging device.

RAM 230 is normally used to store the wireless messages transmitted and received by SCU 124. However, in accordance with the principles of the present invention,

all or portions of RAM 230 are reallocated as space for downloaded target program 232 and update program 234 during an over-the-air (OTA) reprogramming operation (event) for SCU 124. The memory space for update program 234 is further divided into sub-spaces for radio control routine 236 and copy control routine 238.

As previously discussed, when message controller 215 determines that a reprogramming event has been initiated, it causes the content of update program 224 to be copied into RAM 230 space for update program 234. Update program 224 in flash ROM 220 may contain all of radio control routine 236 and copy control routine 238. Alternatively, message controller 215 may copy a portion or all of radio control routine 236 from a part of BIOS program 222. Radio control routine 236 represents the portion of update program 234 which is reserved for software associated with controlling the operation of transceiver 210 during reprogramming events. Radio control routine 236 maintains communication with network 100 through base station 112, including time intervals when SCU 124 is being reprogrammed through OTA update of the present invention.

Copy control routine 238 represents the portion of update program 234 that stores downloaded target program 232 in RAM 234 during the OTA update and then transfers it to flash ROM 220 when the OTA update is complete. Downloaded target program 232 is the replacement program that is received over-the-air from base station 112 and that replaces part of, or all of, the programs initially in flash ROM 220.

An OTA reprogramming event may be initiated in several ways. In one embodiment, SCU 124 may transmit an update request message (reprogramming event) through base

station 112 according to a periodic occurrence, such as reception of a signal from an internal or external clock timer, or intermittently according to a user command or the detection of an error, such as major power interruption or software conflict, and the like. In these cases, control facility 10 comprises means for detecting the presence of the update request message for a specific program update from SCU 124 and responding with a program update command. SCU 124 recognizes the program update command as an indication that a reprogramming event has been initialized.

In a second embodiment, control facility 10 comprises means for detecting an update of a specific program in SCU 124 without regard to receiving an update request from SCU 124. These means are similar to those discussed for SCU 124, such as the expiration of a clock period, a triggering signal, a system error, user command, and the like. In the case of user commands, these may be received through other SCUs, the PSTN, or other means and may include the capability of initiating a reprogramming event for all or a portion of the SCUs associated with network 100. For instance, a particular user with a group of remote telemetry devices may transmit an update command for an application program associated with all of the telemetry devices. Control facility 10 determines that an update command has been received, identifies the SCUs associated with the applicable group, and transmits an update program command to each member of the group, such as SCU 124. Control facility 10 further comprises the means to transfer an update or updates of the targeted program in response to individual and/or multiple OTA reprogramming acknowledgments from applicable SCUs. SCU 124 responds to an unsolicited program update command from base station 112 in the same manner as when SCU 124 first transmits an

update request message. In other words, SCU 124 recognizes the beginning of an OTA reprogramming event with reception of an update program command, regardless of how the event is initiated.

When an OTA update procedure is in progress, SCU 124 initially stores the incoming new program, referred to as "downloaded target program 232" in RAM 230. Subsequently, SCU 124 transfers a copy of downloaded target program 232 to flash ROM 230, overwriting some or all of one or more of BIOS program 222, update program 224, and application program 226. If update program 224 is overwritten, downloaded target program 232 preferably comprises a replacement update program 224, or else the update (reprogramming) capability will be lost.

FIGURE 3 illustrates in greater detail base station 112 and a portion of control facility 10 responsible for performing over-the-air updates in accordance with one embodiment of the present invention. Control facility 10 comprises transceiver interface (IF) 305, which communicates with bases station 112, message controller 310, network interface (IF) 315, update supervisor 320, and memory 325, which stores target program 330. Target program 330 is the update (or replacement) program that must be transmitted to SCU 124 for installation in all or part of flash ROM 220 in order to upgrade and/or replace one or more of the programs therein.

Transceiver IF 305 transfers incoming and outgoing messages between base station 112 and message controller 310. Message controller 310 performs conventional wireless messaging functions and transfers data between transceiver IF 305 and network IF 315. Message controller 310 also transfers data between update

supervisor 320 and either or both of transceiver IF 305 and network IF 315. Under the direction of update supervisor 320, message controller 310 recognizes the initiation of an OTA update procedure, transferring target program 330 as required in support of the OTA update, providing necessary responses during the progression of the OTA update, and returning to normal operation once the OTA update has been completed.

Network IF 315 comprises means for transferring data between one or more end-users and message controller 310. Network IF 315 may interface with end-users through various means, including but not limited to base stations associated with network 10, the public switched telephone network (PSTN), other wireless networks, and other well known and/or specialized interfaces. Update supervisor 320 comprises means for recognizing, monitoring, and/or coordinating an OTA update procedure in conjunction with message controller 310. In addition, update supervisor 320 transfers a replacement program between message controller 310 and target program 330 storage space in memory 325.

FIGURE 4 depicts flow diagram 400, which illustrates an exemplary over-the-air (OTA) update procedure in network 100 in accordance with one embodiment of the present invention. Exemplary control facility 10 initiates a reprogramming event by transmitting an update command through base station 112 to SCU 124 (process step 405). Control facility 10 may transmit the update command in response to internally generated or externally received commands or trigger signals, in response to expiration of a time interval, or in response to an OTA update request message from SCU 124.

SCU 124 recognizes the update command from control facility 10 in an incoming message, causing message controller 215 to halt operation of on-going program(s), to transfer a copy of update program 224 to update program 234 space in RAM 230, and to transfer program control to update program 234 (process step 410). In addition, an automatic acknowledgment message is transferred by SCU 124 to control facility 10 through base station 112, per standard message networking requirements.

Next, control facility 10 transfer target program 330 over the air through base station 112 (process step 415). Subsequently, SCU 124 stores the received program in downloaded target program 232 space in RAM 230. Under the direction of copy control 238, SCU 124 causes at least a portion of downloaded target program 234 to be copied into at least a portion of flash ROM 220 (process step 420).

When the copy procedure is complete and downloaded target program 234 has been successfully copied to the corresponding portions of flash ROM 220, Message controller 215 returns program control to flash ROM 220 and the new replacement is executed (process step 425). SCU 124 returns to "normal" operation until another update command is received.

Those of ordinary skill in the art should appreciate that they can readily use the disclosed conception and specific embodiments as a basis for designing or modifying other structures for carrying out the same purposes of the present invention. Those of ordinary skill in the art should also realize that such equivalent constructions do not depart from the spirit and scope of the present invention in its broadest form.

WHAT IS CLAIMED IS:

1. For use in a wireless messaging device, an update controller for performing an over-the-air (OTA) update of a first program stored in an erasable read-only memory (ROM) in said wireless messaging device comprising:

a transceiver capable of receiving wireless messages from a base station in a forward channel and transmitting wireless messages to said base station in a reverse channel; and

a message controller coupled to said transceiver capable of detecting an OTA update message transmitted by said base station, wherein said message controller, in response to detection of said OTA update message, transfers an update control program stored in said erasable ROM to a random access memory (RAM) coupled to said message controller and executes said update control program from said RAM.

2. The update controller set forth in Claim 1 wherein said message controller, under control of said update control program, receives from said transceiver a second program suitable for replacing said first program and stores at least a portion of said second program in said RAM.

3. The update controller set forth in Claim 2 wherein said message controller, under control of said update control program, transfers at least a portion of said second program from said RAM to said erasable ROM.

4. The update controller set forth in Claim 3 wherein said message controller, in transferring said at

least a portion of said second program to said erasable ROM, overwrites at least a portion of said first program.

5. The update controller set forth in Claim 1 wherein said update controller transmits an update request message to said base station, wherein transmission of said update request message causes said OTA update message to be transmitted to said update controller by said base station.

6. The update controller set forth in Claim 5 wherein said update controller periodically transmits said update request message according to a time period modifiable by a user of said wireless messaging device.

7. The update controller set forth in Claim 5 wherein said update controller transmits said update request message in response to a triggering event.

8. The update controller set forth in Claim 7 wherein said triggering event is at least one of:

a manual input received from a user of said wireless messaging device;

an input received from monitored equipment coupled to said wireless messaging device; and

an error occurring during execution of said first program.

9. For use in a wireless messaging device, a method for performing an over-the-air (OTA) update of a first program stored in an erasable read-only memory (ROM) in the wireless messaging device comprising the steps of:

detecting an OTA update message transmitted by a base station;

in response to detection of the OTA update message, transferring an update control program stored in the erasable ROM to a random access memory (RAM) in the wireless messaging device and executing the update control program from the RAM.

10. The method set forth in Claim 9 including the further steps of receiving a second program suitable for replacing the first program and storing at least a portion of the second program in the RAM.

11. The method set forth in Claim 10 including the further step of transferring at least a portion of the second program from the RAM to the erasable ROM.

12. The method set forth in Claim 11 wherein the step of transferring the at least a portion of the second program to the erasable ROM overwrites at least a portion of the first program.

13. The method set forth in Claim 9 including the further step of transmitting an update request message to the base station, wherein transmission of the update request message causes the OTA update message to be transmitted to the update controller by the base station.

14. The method set forth in Claim 13 wherein the step of transmitting the update request message occurs periodically according to a time period modifiable by a user of the wireless messaging device.

15. The method set forth in Claim 13 wherein the step of transmitting occurs in response to a triggering event.

16. The method set forth in Claim 15 wherein the triggering event is at least one of:

a manual input received from a user of the wireless messaging device;

an input received from monitored equipment coupled to the wireless messaging device; and

an error occurring during execution of the first program.

17. For use in a narrowband wireless messaging network comprising a plurality of base stations capable of transmitting wireless messages in a forward channel to, and receiving wireless messages in a reverse channel from, a wireless communication device, an update apparatus capable of performing an over-the-air (OTA) update of a first program stored in said wireless messaging device comprising:

a message controller capable of transmitting outbound messages to, and receiving inbound messages from, one or more of said plurality of base stations;

an update supervisor capable of detecting an update indicator associated with said wireless messaging device and, in response thereto, transferring a second program to said message controller for transmission to said wireless messaging device via at least one of said plurality of base stations.

18. The update apparatus set forth in Claim 17 wherein said update indicator is an update request message received from said wireless messaging device.

19. The update apparatus set forth in Claim 17 wherein said update indicator is an update command received via a wired data network coupled to said update apparatus.

20. The update apparatus set forth in Claim 17 wherein the update indicator is triggered by an expiration of a user-defined update period.

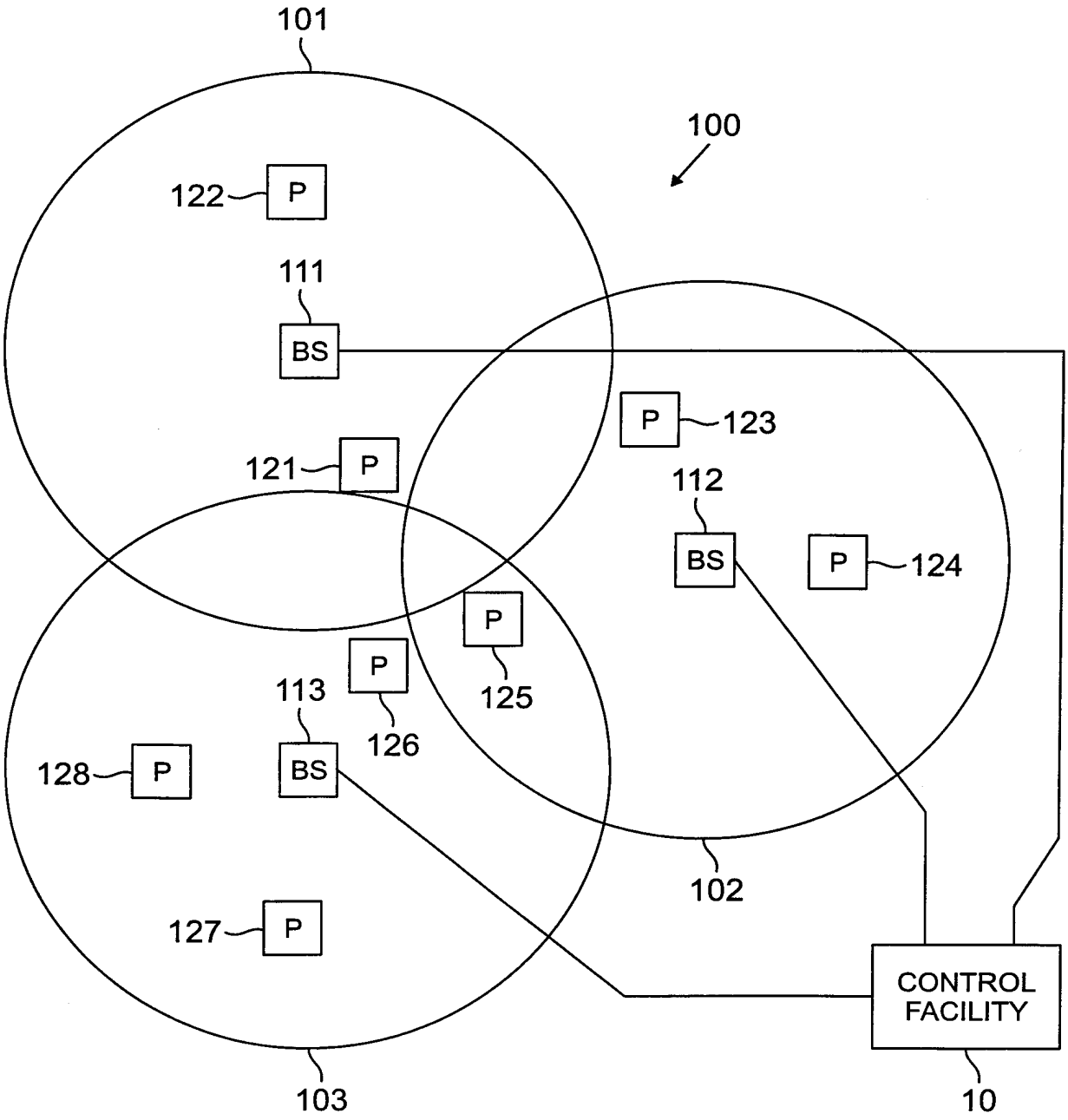

101
100
122
P
111
BS
P
123
121
P
112
BS
P
124
P
125
P
126
113
BS
128
P
102
127
P
CONTROL FACILITY
103
10

FIG. 1

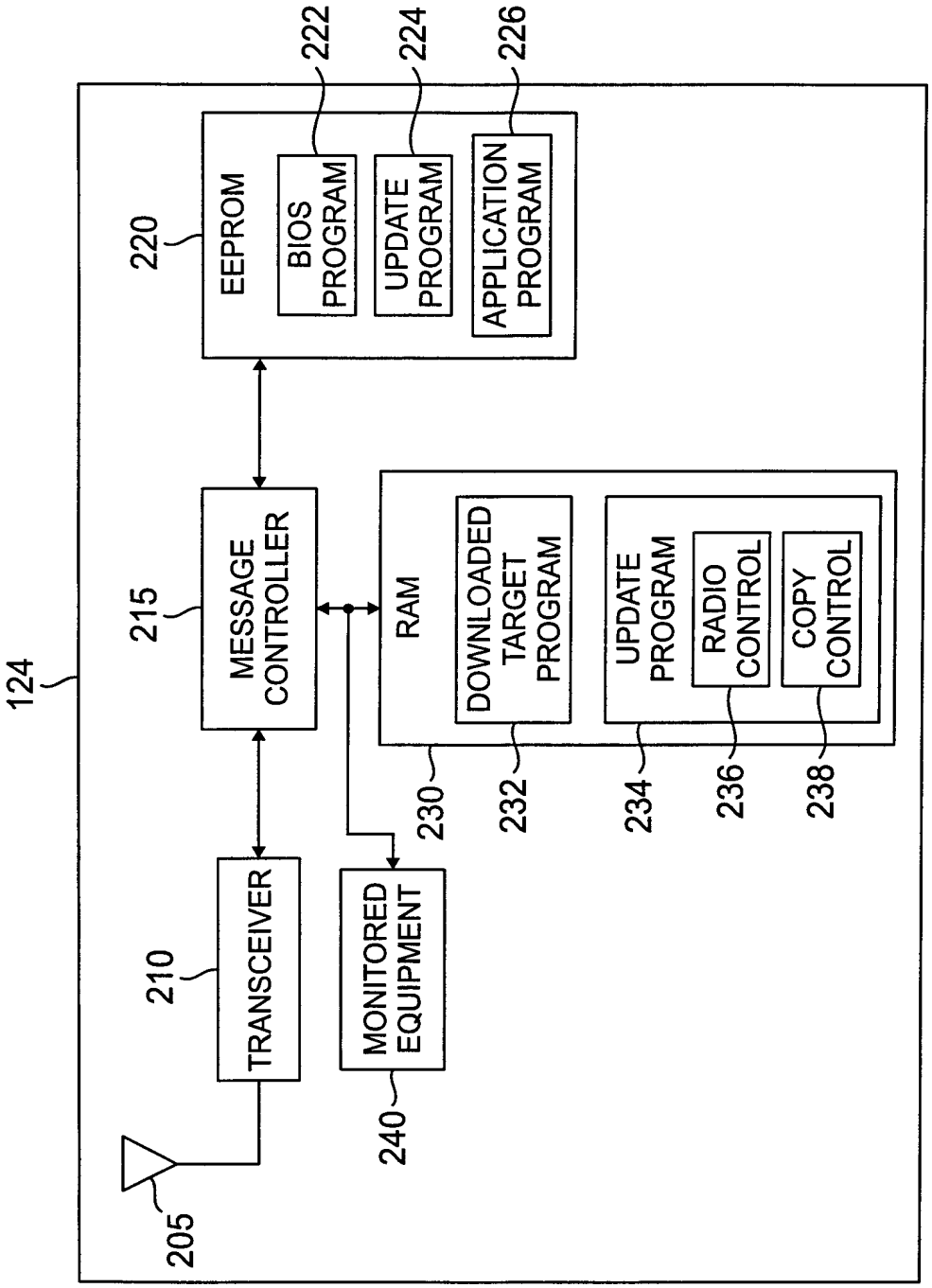

124
205
210
TRANSCEIVER
215
MESSAGE CONTROLLER
220
EEPROM
BIOS PROGRAM
UPDATE PROGRAM
APPLICATION PROGRAM
222
224
226
MONITORED EQUIPMENT
240
RAM
DOWNLOADED TARGET PROGRAM
UPDATE PROGRAM
RADIO CONTROL
COPY CONTROL
230
232
234
236
238

FIG. 2

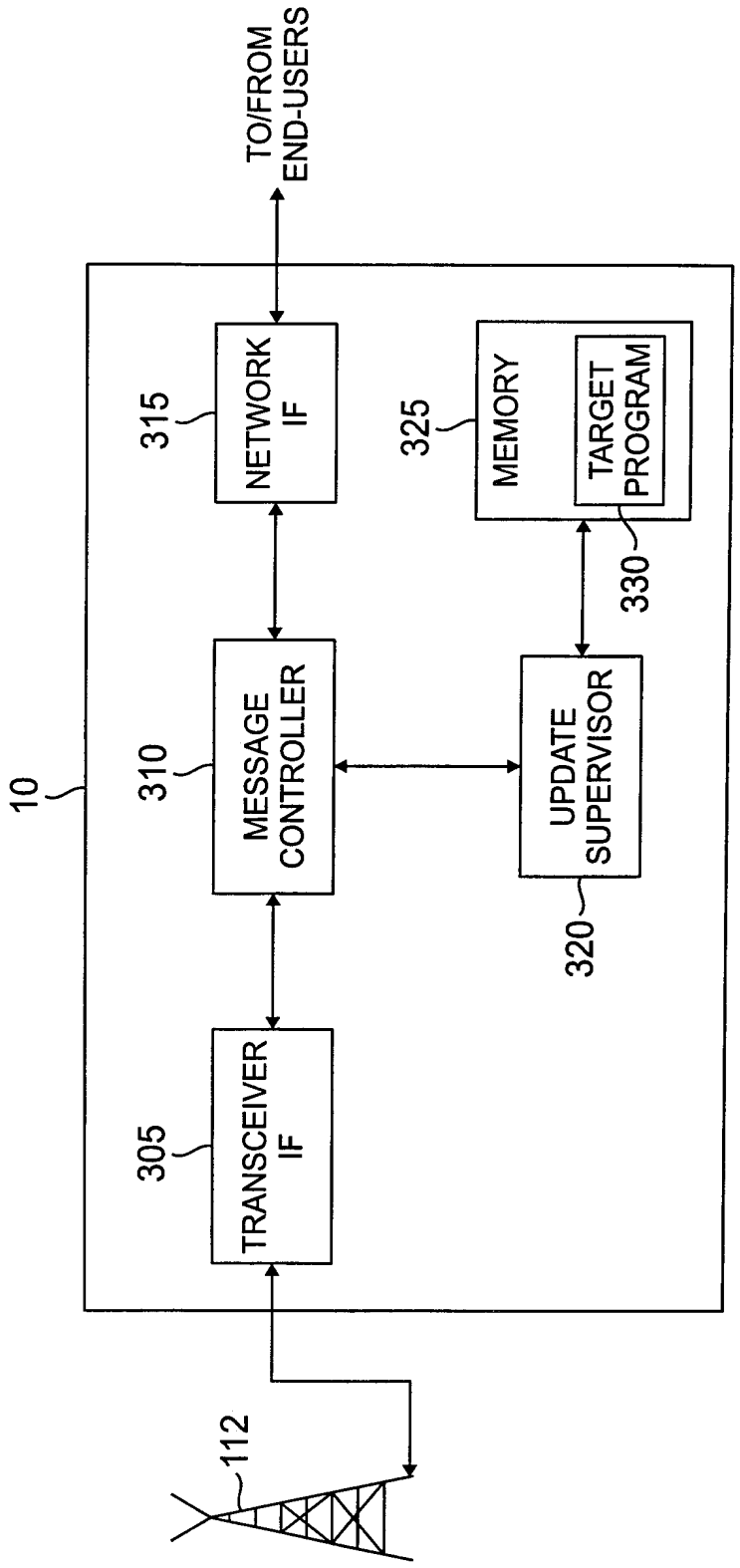

TO/FROM END-USERS
NETWORK IF
315
MEMORY
325
TARGET PROGRAM
330
MESSAGE CONTROLLER
310
UPDATE SUPERVISOR
320
TRANSCEIVER IF
305
10
112

FIG. 3

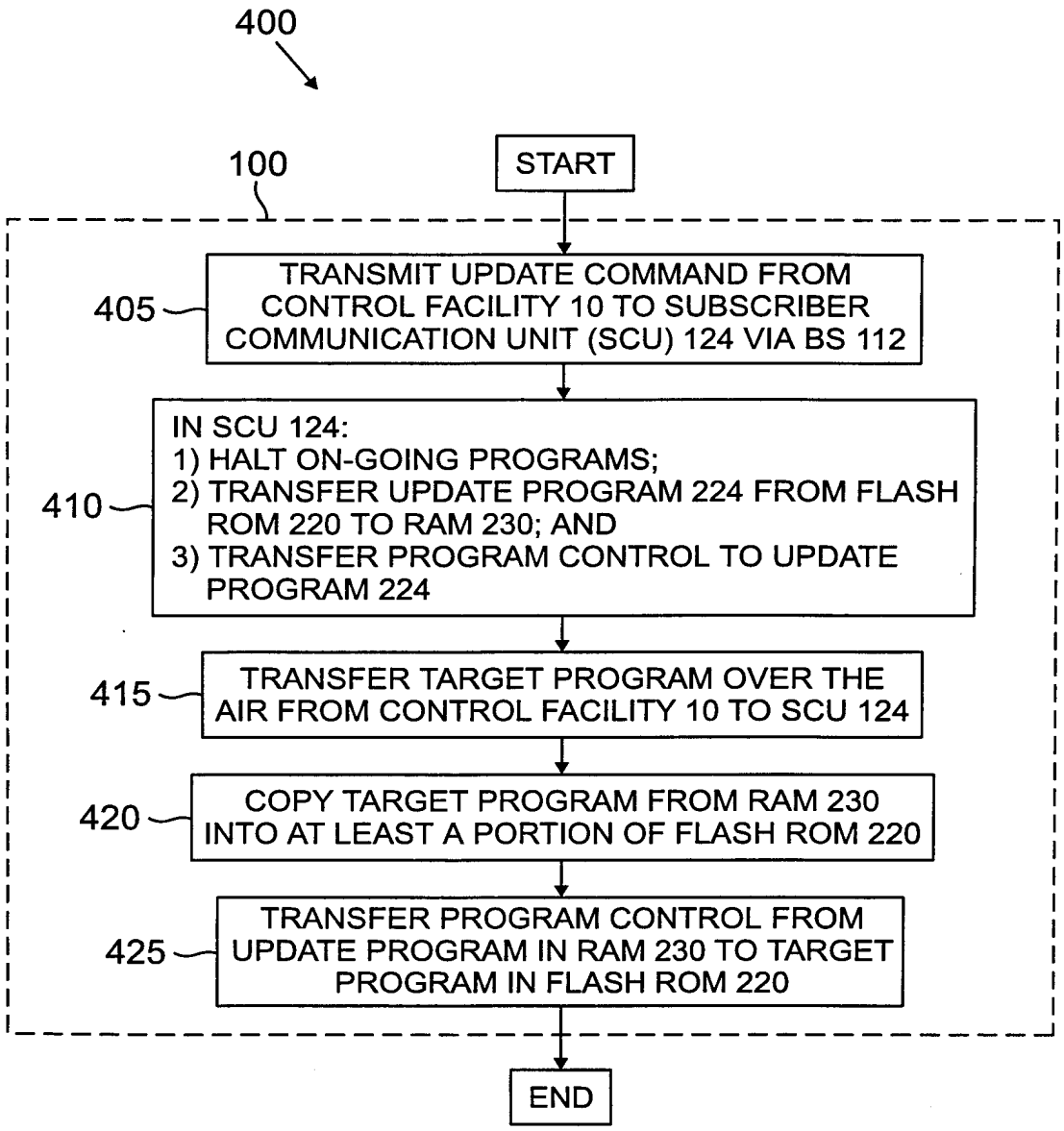

400
100
START
405
TRANSMIT UPDATE COMMAND FROM CONTROL FACILITY 10 TO SUBSCRIBER COMMUNICATION UNIT (SCU) 124 VIA BS 112
410
IN SCU 124:
1) HALT ON-GOING PROGRAMS;
2) TRANSFER UPDATE PROGRAM 224 FROM FLASH ROM 220 TO RAM 230; AND
3) TRANSFER PROGRAM CONTROL TO UPDATE PROGRAM 224
415
TRANSFER TARGET PROGRAM OVER THE AIR FROM CONTROL FACILITY 10 TO SCU 124
420
COPY TARGET PROGRAM FROM RAM 230 INTO AT LEAST A PORTION OF FLASH ROM 220
425
TRANSFER PROGRAM CONTROL FROM UPDATE PROGRAM IN RAM 230 TO TARGET PROGRAM IN FLASH ROM 220
END

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/24022

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :HO4M 3/00
US CL :455/418

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 455/418-420, 422, 575, 566

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST
search terms: update, programming control

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,761,618 A (LYNCH ET AL) 02 JUNE 1998, SEE FIGS. 1-8.	1-20
A, P	US 6,023,620 A (HANSSON) 08 FEBRUARY 2000, SEE FIGS. 1-2.	1-20
A, P	US 6,044,265 A (ROACH, JR.) 28 MARCH 2000, SEE FIGS. 1-6.	1-20
A, P	US 6,041,124 A (SUGITA) 21 MARCH 2000, SEE FIGS. 1-13D.	1-20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search
29 SEPTEMBER 2000

Date of mailing of the international search report
08 NOV 2000

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